SPECIFICATION AMENDMENTS

This application claims priority to PCT Application Number PCT/DE00/01883 filed June 14, 2000.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The invention ~~develops from~~ is a method and/or a device for connecting plates lying on top of one another according to ~~the~~ a clinching process. ~~of the generic principal claim and the secondary claim 8.~~

DESCRIPTION OF RELATED ART

Two prior art methods and/or devices are known for clinching. ~~i.e. for once~~ The first uses a die without a cutting part and on the other uses ~~hand~~ a die with ~~such~~ a cutting part. The cutting part separates the deep-drawn plate section in portions from the plate, which it is ~~where it was~~ drawn from. During the non-cutting clinching the deep-drawn plate sections flow radially outwards during the squeezing ~~radial outwards, like snap fasteners,~~ and sub-seize the plates like snap fasteners. Particularly when ~~then, if~~ a connection between ~~from~~ plates of different hardness or materials takes place, different stresses result from the different consistencies. ~~consistency, which can be a~~ This is a disadvantage for the connection. ~~On the one hand a certain~~ A weakening results through the deep-drawing and ~~therefore occurring~~ thinning of the material occurs. ~~, on the other hand a~~ A spike-connection of the material results through the sub-seizing. ~~, what represents the actual connection.~~

With a well-known connection device, as exemplified by DE OS 35 32899, ~~(DE OS 35 32 899)~~ plate pieces lying on top of each other are punched by punching cams along a part of their outlining lines and are deep-drawn from the plate plane, after which, by means of the die and a back pressure area in the bottom die, the plate section closer to the plates is widened by squeezing and sub-seizes the first plate. Apart from the fact that an unretentive spot within the area of the connection results in the plate, such a punching procedure causes a substantial reduction of the strength. ~~, which~~ The reduction in strength does not occur with another well-known generic clinching process, as exemplified by EP-PS 0,215,449 ~~(EP-PS 0,215,449), with~~ in which the plate sections are deep-drawn by the die into a deep-drawing opening and are afterwards squeezed wide. This results in an extremely actuated and positive locking joint point. ~~, which however again can~~ However, this method leads ~~lead~~ to connecting problems ~~with~~

~~different materials of the~~ when the plates are made of ~~plates~~ different materials.~~, as aforementioned above. Suring such a snap fastener like connection,~~ A ~~the~~ spike-connection, is simply not as strong as with the unilateral punching cam.

In order to address some of the deficiencies of the prior art methods, ~~accommodate for that,~~ there are known clinching processes ~~(PCT/EP 96/0305, WO 97/02912)~~, exemplified by, e.g. PCT/EP96/0305 and WO97/02912 in which the side walls of the deep-drawing opening are designed to be flexible, so that after the deep-drawing procedure desired clearances result for the squeezing procedure. Apart from ~~form~~ the fact that due to the ~~lacking~~ lack of radial resistance an actuated interlinking of the displaced and sub-seized materials cannot take place, by which clearances causing a loosening would be filled, tensions caused by the axially symmetrical radial expansion remain in the connecting point.~~, which~~ The tensions are not reduced however, ~~which likewise~~ and ~~depends~~ depend on the radial yielding of the walls of the deep-drawing opening and which occur ~~happens~~ at the expense of the strength of the connection. ~~connecting point.~~

SUMMARY OF THE INVENTION

~~The method of the invention according to the principal claim, and/or the device of the invention for the working of the method according to the secondary claim 8, has in contrast to this the benefit~~ One of the benefits of the inventive method and device is that plates of different materials can be connected with high strength. ~~So also~~ As a result, plates from metal and plastic for example, can be connected~~,~~ with sufficient durability. It is particularly beneficial ~~favorable~~ that due to the different deformations ~~deformation~~ in two cross directions of the plate sections, a relatively strong material displacement takes place in the first cross direction and ~~their~~ the transitions to the second cross direction with ~~corresponding~~ correspondingly strong sub-seizing of the plates by the plate sections.~~, however at the of the thickness and also the strength of the wall parts.~~ Whereas, in the second cross direction due to the wedge form of the die ~~fewer~~ less material is displaced ~~and~~ so that the connecting neck between the bases of the plate sections and the plates is relatively thick and thus very firmly designed. Since the transition between these two extremes is flexible, the strong neck of the wall parts in the second cross direction ~~works itself~~ and the strong sub-seizing by the plate sections in the first cross direction, in combination result in a total improvement of the connection, ~~for example also~~ as compared with all other well-known clinching connections.

~~After a favorable~~ In one embodiment of the method according to the invention, the die and the deep-drawing opening exhibit a circular cross-section or an oval cross-section and the work area of the die is has a wedge-shape ~~designed wedge-shaped~~ with an essentially rectangular front surface., ~~so that~~ As a result, at the opposite sides of the die strong thinning, up to tear separation of the wall parts of the second and additional plate sections take place, so that the radial displacement is held back by the wedge areas.

~~After a further favorable~~ In another embodiment of the invention, the volume of the deep-drawing opening is constant in the press direction and transverse to the press direction, ~~so that~~ As a result, during the squeezing procedure the longitudinal extension, as well as the transverse extension, of the deep-drawn plate sections is limited ~~unyieldingly~~ and an edge area, running in deep-drawing direction, results ~~(EP 2,215,449)~~.

~~After a further favorable~~ In yet another embodiment of the invention, the volume of the deep-drawing opening can be increased in longitudinal extension and/or transverse extension ~~(DE-GM 297 00 868, WO 97/02912)~~.

~~After a further favorable~~ In yet another embodiment of the invention, existing edges of recesses, pointing towards the plate section, engage during the squeezing procedure at the base of the deep-drawing opening in the first plate section and obstruct the radial outward flow of the material, whereby displaced material from ~~form~~ the second or above plate section flows into the resulting radial clearances.

~~After a further favorable~~ In yet another embodiment of the invention, the obstruction of the radial outward flows takes place in the first cross direction. The edges obstructing the radial outward flow can ~~of course run~~ also run in other directions~~, if this is of advantage for the inventive procedure~~.

~~After a further favorable~~ In yet another embodiment of the invention, the first and third plate can be made ~~consist~~ of metal and the second plate lying between them can be made ~~consist~~ of plastic. Such material combinations could ~~so far~~ not previously be connected ~~satisfactory~~ satisfactorily in a clinching process, since the soft intermediate material prevented the required form-fit and grip.

~~After an~~ In another embodiment of the invention, ~~concerning the device according to claim 8~~ the die is above the wedge shape and the deep-drawing opening exhibits a circular or oval cross section.

~~After a further favorable~~ In another embodiment of the invention, the deep-drawing opening in the bottom die is designed in radial and axial directions ~~direction~~ as a blind opening~~,~~ whose side walls run in the direction of movement of the die and are unyielding~~., like the~~ The bottom plane of the deep-drawing opening is also unyielding.

~~After and~~ In an alternative ~~favorable~~ embodiment of the invention, the base of the deep-drawing opening, although ~~actually~~ unyielding, can be adjusted a certain stroke length when ~~exceeding~~ a certain pressing force of the die is exceeded.

~~After a further favorable~~ In another embodiment of the invention, a recess is provided in the base of the deep-drawing opening~~,~~ whereby the recess exhibits edges towards the bottom plane~~.,~~ ~~which~~ The edges fit into the plate section after the deep-drawing, in order to obstruct ~~thereby~~ the radial flow of material during the squeezing procedure~~.,~~ ~~what~~ This in turn creates clearances~~,~~ into which the material of the second or above plate sections can flow.

~~After a further favorable~~ In another embodiment of the invention the recesses are designed as concentric or central symmetrical key grooves~~, which~~ are arranged continuously and/or misaligned to each other.

Further benefits and favorable embodiments of the invention ~~can be taken~~ will be understood from the following description, ~~of~~ the drawings, ~~drawing~~ and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

A design example of the subject of the invention is represented in the drawing and is following described in more detail. Shown are:

Figure 1 a tool unit, including plates, before ~~their~~ processing
Figure 2 a view in accordance with arrow II in Figure ~~figure~~ 1
Figure 3 a section in accordance with arrow III in Figure ~~figure~~ 1

Figure 4 a section through a finished connection point, according to the tool position in ~~figure~~ Figure 1, but in different scale and

Figure 5 a section through a finished connection point in accordance with ~~figure~~ Figure 4, ~~however it is~~ rotated 90°.

DETAILED DESCRIPTION OF THE INVENTION

In ~~Figure~~ Figures 1-2, a die 1 is shown in ~~its~~ side view, which The die exhibits a work peg 2 and a retention shank 3, each having a circular cross section, ~~as it also can be seen in Figure 2.~~ The peg 2 exhibits a front surface 4 and flattenings 5~~, what creates kind of~~ that create a wedge shape. As ~~it~~ can be seen in Figure 2, the front surface 4 ~~creates~~ together with the lateral surface 6 of the peg 2 create deep-drawing edges 7. In Figure 1, only the front edge can be seen. This die is located in a press with a tool holder, in order to be able to accomplish a force stroke in direction of the arrow 1, ~~what~~ The press is not shown in detail.

Underneath the die 1, a bottom die 8 is located in the press, ~~with~~ The bottom die 8 has a deep-drawing opening 9, with firm radial walls 10 and a ~~likewise~~ immovable base 11. Between base 11 and wall 10, a circular groove 12 is provided. In the base, ~~itself~~ a recess in the shape of a key groove 13 is located~~,~~ ~~which~~ The recess exhibits edges 14 towards the bottom space. In the section through the bottom die shown in ~~figure~~ Figure 3, it can be seen ~~clearly~~ that this key groove 13 leads into the circular groove 12 ~~at its two ends~~.

Three plates are put on ~~the~~ bottom die 8, ~~i.e.~~ e.g. two metal plates 15 and 17 and a plastic plate 16 arranged between them. ~~In order to~~ To create a connection according to the invention between the three plates 15, 16 and 17, the die 1 is driven downward in the direction of the arrow 1, whereby it deep-draws in the first part of its operating cycle the three plates 15, 16 and 17 into the deep-drawing opening 9, until the first lower plate 15 touches the base 11. After this, due to the resulting resistance and the continued pressing power, the three plates are squeezed together. During this squeezing procedure~~,~~ the first plate 15 is pressed into ~~the~~ key groove 13~~,~~ so that ~~thereby~~ the flow process is obstructed in the radial direction ~~radial outward~~. The squeezed material thus flows primarily in the direction of the serration, instead of crosswise into it. The plate sections of the plates 16 and 17, which are drawn into the deep-drawing opening 9 during the deep-drawing procedure, are thinned and, if necessary, separated ~~in the corresponding places~~ by the squeezing procedure transverse to their course.

In ~~figure~~ Figure 4, a section view through a finished connection point is shown, ~~which~~ It corresponds to the ~~represented~~ position of the die 1.

In Figure 5, a section view through the same connection point is shown, ~~however~~ However, it is rotated 90°, ~~i.e. that here splittings~~ Splittings 18 on the inside of the point are created by the deep-drawing edges 7. During this separation process, the first plate 15 is not affected, ~~according to the invention.~~ As ~~it~~ can be seen in Figure 5, the deep-drawn and squeezed plate section 19 belonging to ~~the~~ plate 15 shows elevations 20, created by the circular groove 12 and the key groove 13. ~~The plate~~ Plate section 21 of ~~the~~ plate 16, ~~consisting~~ made of plastic, and ~~the~~ plate section 22 of ~~the~~ third plate 17 are partially separated from each other by the deep-drawing edges, ~~according to the section in Figure 5, while in the other, 90° rotated position, these~~ In a position rotated 90°, plate sections 19, 21 and 22 are still fully connected with the plates 15, 16, 17.

~~All features represented in the description, the following claims and the drawing can be substantial for the invention both individually and in arbitrary combination with one another.~~

Reference number list

1	Die
2	Work peg
3	Retention shank
4	Front surface
5	Flattenings
6	Lateral surface
7	Deep-drawing edges
8	Bottom die
9	Deep-drawing opening
10	Side walls
11	Base
12	Circular groove
13	Key groove
14	Edges
15	Metal plate
16	Plastic plate
17	Metal plate
18	Splitting
19	Plate section
20	Elevations
21	Plate section
22	Plate section

SPECIFICATION AS AMENDED

This application claims priority to PCT Application Number PCT/DE00/01883 filed June 14, 2000.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The invention is a method and/or a device for connecting plates lying on top of one another according to a clinching process.

DESCRIPTION OF RELATED ART

Two prior art methods and/or devices are known for clinching. The first uses a die without a cutting part and on the other uses a die with a cutting part. The cutting part separates the deep-drawn plate section in portions from the plate, which it is drawn from. During the non-cutting clinching the deep-drawn plate sections flow radially outwards during the squeezing and sub-seize the plates like snap fasteners. Particularly when a connection between plates of different hardness or materials takes place, different stresses result from the different consistencies. This is a disadvantage for the connection. A weakening results through the deep-drawing and thinning of the material occurs. A spike-connection of the material results through the sub-seizing.

With a well-known connection device, as exemplified by DE OS 35 32899, plate pieces lying on top of each other are punched by punching cams along a part of their outlining lines and are deep-drawn from the plate plane, after which, by means of the die and a back pressure area in the bottom die, the plate section closer to the plates is widened by squeezing and sub-seizes the first plate. Apart from the fact that an unretentive spot within the area of the connection results in the plate, such a punching procedure causes a substantial reduction of the strength. The reduction in strength does not occur with another well-known generic clinching process, as exemplified by EP-PS 0,215,449 in which the plate sections are deep-drawn by the die into a deep-drawing opening and are afterwards squeezed wide. This results in an extremely actuated and positive locking joint point. However, this method leads to connecting problems when the plates are made of different materials. A spike-connection, is simply not as strong as with the unilateral punching cam.

In order to address some of the deficiencies of the prior art methods, there are known clinching processes, exemplified by, e.g. PCT/EP96/0305 and WO97/02912 in which the side walls of the deep-drawing opening are designed to be flexible, so that after the deep-drawing procedure desired clearances result for the squeezing procedure. Apart from the fact that due to the lack of radial resistance an actuated interlinking of the displaced and sub-seized materials cannot take place, by which clearances causing a loosening would be filled, tensions caused by the axially symmetrical radial expansion remain in the connecting point. The tensions are not reduced however, and depend on the radial yielding of the walls of the deep-drawing opening and which occur at the expense of the strength of the connection.

SUMMARY OF THE INVENTION

One of the benefits of the inventive method and device is that plates of different materials can be connected with high strength. As a result, plates from metal and plastic for example, can be connected, with sufficient durability. It is particularly beneficial that due to the different deformations in two cross directions of the plate sections, a relatively strong material displacement takes place in the first cross direction and the transitions to the second cross direction with correspondingly strong sub-seizing of the plates by the plate sections. Whereas, in the second cross direction due to the wedge form of the die less material is displaced so that the connecting neck between the bases of the plate sections and the plates is relatively thick and thus very firmly designed. Since the transition between these two extremes is flexible, the strong neck of the wall parts in the second cross direction and the strong sub-seizing by the plate sections in the first cross direction, in combination result in a total improvement of the connection, as compared with all other well-known clinching connections.

In one embodiment of the method according to the invention, the die and the deep-drawing opening exhibit a circular cross-section or an oval cross-section and the work area of the die is has a wedge-shape with an essentially rectangular front surface. As a result, at the opposite sides of the die strong thinning, up to tear separation of the wall parts of the second and additional plate sections take place, so that the radial displacement is held back by the wedge areas.

In another embodiment of the invention, the volume of the deep-drawing opening is constant in the press direction and transverse to the press direction. As a result, during the squeezing

procedure the longitudinal extension, as well as the transverse extension, of the deep-drawn plate sections is limited and an edge area, running in deep-drawing direction, results.

In yet another embodiment of the invention, the volume of the deep-drawing opening can be increased in longitudinal extension and/or transverse extension.

In yet another embodiment of the invention, existing edges of recesses, pointing towards the plate section, engage during the squeezing procedure at the base of the deep-drawing opening in the first plate section and obstruct the radial outward flow of the material, whereby displaced material from the second or above plate section flows into the resulting radial clearances.

In yet another embodiment of the invention, the obstruction of the radial outward flows takes place in the first cross direction. The edges obstructing the radial outward flow can also run in other directions.

In yet another embodiment of the invention, the first and third plate can be made of metal and the second plate lying between them can be made of plastic. Such material combinations could not previously be connected satisfactorily in a clinching process, since the soft intermediate material prevented the required form-fit and grip.

In another embodiment of the invention, the die is above the wedge shape and the deep-drawing opening exhibits a circular or oval cross section.

In another embodiment of the invention, the deep-drawing opening in the bottom die is designed in radial and axial directions as a blind opening, whose side walls run in the direction of movement of the die and are unyielding. The bottom plane of the deep-drawing opening is also unyielding.

In an alternative embodiment of the invention, the base of the deep-drawing opening, although unyielding, can be adjusted a certain stroke length when a certain pressing force of the die is exceeded.

In another embodiment of the invention, a recess is provided in the base of the deep-drawing opening whereby the recess exhibits edges towards the bottom plane. The edges fit into the

plate section after the deep-drawing, in order to obstruct the radial flow of material during the squeezing procedure. This in turn creates clearances, into which the material of the second or above plate sections can flow.

In another embodiment of the invention the recesses are designed as concentric or central symmetrical key grooves are arranged continuously and/or misaligned to each other.

Further benefits and favorable embodiments of the invention will be understood from the following description, the drawings, and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

A design example of the subject of the invention is represented in the drawing and is following described in more detail. Shown are:

Figure 1 a tool unit, including plates, before processing

Figure 2 a view in accordance with arrow II in Figure 1

Figure 3 a section in accordance with arrow III in Figure 1

Figure 4 a section through a finished connection point, according to the tool position in Figure 1, but in different scale and

Figure 5 a section through a finished connection point in accordance with Figure 4, rotated 90°.

DETAILED DESCRIPTION OF THE INVENTION

In Figures 1-2, a die 1 is shown in side view. which The die exhibits a work peg 2 and a retention shank 3, each having a circular cross section. The peg 2 exhibits a front surface 4 and flattenings 5 that create a wedge shape. As can be seen in Figure 2, the front surface 4 together with the lateral surface 6 of the peg 2 create deep-drawing edges 7. In Figure 1, only the front edge can be seen. This die is located in a press with a tool holder, in order to be able to accomplish a force stroke in direction of the arrow 1. The press is not shown in detail.

Underneath the die 1, a bottom die 8 is located in the press. The bottom die 8 has a deep-drawing opening 9, with firm radial walls 10 and a immovable base 11. Between base 11 and wall 10, a circular groove 12 is provided. In the base, a recess in the shape of a key groove 13

is located. The recess exhibits edges 14 towards the bottom space. In the section through the bottom die shown in Figure 3, it can be seen that this key groove 13 leads into the circular groove 12.

Three plates are put on bottom die 8, e.g. two metal plates 15 and 17 and a plastic plate 16 arranged between them. To create a connection according to the invention between the three plates 15, 16 and 17, the die 1 is driven downward in the direction of the arrow 1, whereby it deep-draws in the first part of its operating cycle the three plates 15, 16 and 17 into the deep-drawing opening 9, until the first lower plate 15 touches the base 11. After this, due to the resulting resistance and the continued pressing power, the three plates are squeezed together. During this squeezing procedure the first plate 15 is pressed into key groove 13 so that the flow process is obstructed in the radial direction. The squeezed material thus flows primarily in the direction of the serration, instead of crosswise into it. The plate sections of the plates 16 and 17, which are drawn into the deep-drawing opening 9 during the deep-drawing procedure, are thinned and, if necessary, separated by the squeezing procedure transverse to their course.

In Figure 4, a section view through a finished connection point is shown. It corresponds to the position of the die 1.

In Figure 5, a section view through the same connection point is shown. However, it is rotated 90°. Splittings 18 on the inside of the point are created by the deep-drawing edges 7. During this separation process, the first plate 15 is not affected. As can be seen in Figure 5, the deep-drawn and squeezed plate section 19 belonging to plate 15 shows elevations 20, created by the circular groove 12 and the key groove 13. Plate section 21 of plate 16, made of plastic, and plate section 22 of third plate 17 are partially separated from each other by the deep-drawing edges. In a position rotated 90°, plate sections 19, 21 and 22 are still fully connected with the plates 15, 16, 17.

Reference number list

23	Die
24	Work peg
25	Retention shank
26	Front surface
27	Flattenings
28	Lateral surface
29	Deep-drawing edges
30	Bottom die
31	Deep-drawing opening
32	Side walls
33	Base
34	Circular groove
35	Key groove
36	Edges
37	Metal plate
38	Plastic plate
39	Metal plate
40	Splitting
41	Plate section
42	Elevations
43	Plate section
44	Plate section